Pokhara University
Faculty of Science and Technology

Course Code: MTH 210	Full Marks: 100
Course title: Calculus II (3-2-0)	Pass Marks: 45
Nature of the Course: Theory	Total Lectures: 45 hours
Level: Bachelor	Program: BE

1. Course Description

The Calculus II is designed to develop the competency of the students in the applications of various mathematical concepts they learned in previous semesters. It is mainly equipped with Vector Calculus, Laplace transform, Multiple integrals, Differential Equations, Fourier Series and with introduction of Partial differential equations. The pre-requisite for this course is Calculus I and Algebra & Geometry. The course will be delivered through lecture method, assignments on practically based engineering problems and class tests.

2. General Objectives

The course is designed to acquaint the students with applications of mathematics in engineering.

3. Methods of Instruction

Lecture, tutorials, discussions and assignments

4. Contents in Detail

Specific objectives	Contents
Evaluate multiple integrals	**Unit I: Multiple Integrals (6 Hours)** 1.1 Introduction 1.2 Double integrals in Cartesian and polar form, Fubini's theorem (statement only), change of order of integration, change of variable from in double integral Jacobian matrix and reduction into Polar. 1.3 Triple integrals in Cartesian form and Dirichlet's Integral, use of cylindrical and spherical coordinates to evaluate triple integral. 1.4 Application of double and triple integrals to find Area and volume.
Analyze the concept of solution of differential equations in terms of infinite series as power series.	**Unit II: Series Solution of Differential Equations and Special Functions (6 Hours)** 2.1 Power series method of solution of differential equations. 2.2 Legendre's Equation, Legendre's polynomials $P_n(x)$ of . Graph of $P_1(x), P_2(x), P_3(x)$. 2.3 Frobenius method. Bessel's equation, Bessel's function $J_\nu(x)$ and its properties. Graph of $J_\nu(x)$ for $\nu = 1\ and\ 2$
Apply the integral transform in solving practical problems	**Unit III: Laplace Transform and Its Application (8 Hours)** 3.1 Laplace Transform (LT), Inverse LT, Linearity of LT, LT of elementary functions, inverses and first shifting (s-shifting) theorem. Existence theorem of Laplace transform (without proof) and uniqueness. 3.2 Transform of Derivative and Integrals of a function. 3.3 Differentiation and Integration of Laplace transform.

	3.4 Unit step function, periodic function and LT, second shifting (t-shifting) theorem. 3.5 Convolution theorem and its application to find inverse. 3.6 Application of Laplace transform to find the solutions of ordinary differential equations (IVP).
Solve higher dimensional (multivariable) calculus problems	**Unit IV: Advanced Vector Calculus (15 Hours)** 4.1 Differentiation of vector function of scalar variable. 4.2 Point functions, Gradient, directional derivative, divergence and curl with properties (without proof) 4.3 Line integral with physical interpretation and evaluation of line integrals on various path 4.4 Line integral, potential function and independence of path 4.5 Green's theorem in plane (without proof) and its various applications 4.6 Surface integral and evaluation of surface integrals 4.7 Stoke's theorem (without proof) and its applications 4.8 Gauss Divergence theorem (without proof) and its applications.
Illustrate periodic functions of practical importance by infinite trigonometric series	**Unit V: Fourier Series (5 Hours)** 5.1 Periodic Functions, odd and even functions 5.2 Fourier series of 2π periodic functions in the interval $(\alpha, \alpha + 2\pi)$. 5.3 Fourier series of $2l$ periodic functions. 5.4 Fourier series of odd and even functions, sine and cosine series
Interpret physical phenomenon by partial differential equations	**Unit VII: Partial Differential Equations (5 Hours)** 7.1 Introduction 7.2 Linear constant coefficient equation 7.3 Applications in conservation laws, the breaking time, shock waves, nonlinear advection equations, and traffic flow.

Note: The figures in the parentheses indicate the approximate periods for the respective units.

5. List of Tutorials (30 hours)

Tutorial work covers the work to be done in tutorial. This will enable the students to compute the mathematical problems under the supervision of the course leader. The major tutorial works are as follows:

Unit	Unit name	List of Tutorials	Tutorial hours
1	Unit I: Multiple Integrals	1.1 Problems on double integral by changing order of integration and reduction into polar. 1.2 Triple integral with examples on Dirichlet's integrals, use Cylindrical and Spherical coordinates. 1.3 Problems on area and volume by double and triple integral	2 hrs 1 hr 1 hr
2	Unit II: Series Solution of Differential	2.1 Solve Legendre's polynomials $P_n(x)$ of different order. 2.2 Solve Bessel's function $J_v(x)$ and their properties.	2 hrs 2 hrs

	Equations and Special Functions		
3	Unit III: Laplace Transform and Its Application	3.1Problems on Laplace and Inverse Laplace transform of different functions. 3.2 Solution of IVP using Laplace transform.	2 hrs 2 hrs
4	Unit IV: Advanced Vector Calculus	4.1 Problems on gradient, Normal vector to a surface, Directional derivative, angle between two surfaces. 4.2 Problems on divergence and curl. 4.3Problems on line integrals, Exactness and path independence. 4.4 Problems based on Green's theorem, Stoke's theorem and Gauss divergence theorem.	2 hrs 2 hrs 3 hrs 3 hrs
5	Unit V: Fourier Series	5.1 Problems on Fourier series in $(-\pi,\pi),(0,2\pi) and\ \left(-\frac{\pi}{2},\frac{3\pi}{2}\right)$. 5.2 Problems on Fourier series of odd and even functions, Fourier series in general interval $(-l,l)$.	2 hrs 2 hrs
6	Unit VII: Partial Differential equation	6.1 Solve partial differential equations and their applications.	4 hrs

6. Evaluation System and Students' Responsibilities

Evaluation System

In addition to the formal exam(s), the internal evaluation of a student may consist of quizzes, assignments, lab reports, projects, class participation, etc. The tabular presentation of the internal evaluation is as follows.

Internal Evaluation	Marks	External Evaluation	Weight	Marks
Attendance & Class Participation	10%	**Semester End Board Examination**	**50%**	50
Assignments	20%			
Presentations/Quizzes	10%			
Term exam	60%			
Total Internal	50			
Full Marks: 50 + 50 = 100				

Students' Responsibilities

Each student must secure at least 45% marks in internal evaluation with 80% attendance in the class in order to appear in the Semester End Examination. Failing to get such score will be given NOT QUALIFIED (NQ) and the student will not be eligible to appear the Semester-End Examinations. Students are advised to attend all the classes, formal exam, test, etc. and complete all the assignments within the specified time period. Students are required to complete all the requirements defined for the completion of the course.

7. Prescribed Books and References

Text Books

1. Kreyszig, E. *Advance Engineering Mathematics,* New Delhi: John Wiley and Sons Inc.
2. Stewart, J. *Calculus, Early Transcendental*. India; Cengage Learning.

References

1. Dass, H. K. & Verma R. *Higher Engineering Mathematics*. New Delhi: S Chand Publishing.
2. Mishra, P., Mishra, R., Mishra, V. P., & Mishra, M. *Advance Engineering Mathematics*. New Delhi: V. P. Mishra Publication.
3. Thomas, G. & Finney, R. *Calculus and Analytical Geometry.* New Delhi: Narosa Publishing House.